Eastern Bering Sea Pacific cod

Grant Thompson presented the two candidate models, which are the same as last year. Model 11.5 (new numbering) has been the reference mode since 2011. Important distinguishing features include externally fixed natural mortality (0.34) and trawl survey catchability (0.77); double normal fishery and survey selectivities; age-based survey selectivity; left limb of survey selectivity allowed to vary over time; fishery length-based fishery selectivity estimated by gear, season, and blocks of years. The dev vectors in the assessment (for recruitment and left limb of survey selectivity) were tuned in 2009 so that input and output standard deviations were equal. The tuning has not been updated since then. The fixed survey catchability (0.77) has become increasingly suspect in recent years. It was initially derived from the record of vertical (off-bottom) distribution of 11 fish with archival tags and the supposition that fish would not respond (e.g., by diving) to the approach of the survey trawl. Field experiments with a high-opening trawl and analysis of acoustic records by RACE scientists have since produced no evidence that any cod are passing above the headrope of the standard survey trawl. When survey catchability was estimated freely in the 2013 preliminary assessment, the estimate of survey catchability increased substantially and the estimate of current spawning biomass dropped by 56%.

The other candidate model, numbered 14.2, has been in development for the last couple of years, and has a number of features viewed by all parties as improvements on the base model, including: a single fishery and season each year, with changes in composite fishery selectivity accommodated by annual variation; a nonparametric formulation of age-specific fishery and survey selectivity (Stock Synthesis pattern 17), also with potential annual variation; internally estimated natural mortality and average survey catchability; and annual deviations in survey catchability. The tuning of Model 14.2 is more complicated than 11.5 as it involves tuned prior distributions on the age-specific selectivities and application of the Thompson-Lauth algorithm to obtain the standard deviations of year-to-year changes in selectivities.

The two models produce almost equal estimates of historical mean recruitment level and year-class strengths, but quite different estimates of present abundance and ABC/OFL. For Model 11.5 the 2016 ABC/OFL are 332,000/390,000 t, and for Model 14.2 184,000/215,000 t. The divergence in abundance estimates occurs in the last few years; for 2010 they are equal. Grant also reported a fit of Model 11.5 with survey catchability fixed at 1.0, which was requested before the meeting by a Team member. The 2016 ABC/OFL values from this fit are 210,000/248,000 mt, increasing to 230,000/262,000 mt for 2017.

Model 11.5 has a number of unattractive features. One is the less likely low fixed value of survey catchability. It also has a strong retrospective pattern, with each year's estimate of abundance being revised downward substantially as additional years of data are added. Both features suggest that the model's estimate of present abundance and hence ABC/OFL are too high. Model 14.2 fits the data better, has no retrospective pattern, and estimates survey catchability freely (at 1.06), but has its own problems. Selectivity pattern 17 appears to be causing numerical difficulties (large values in the final gradient vector), and the Thompson-Lauth algorithm has proved difficult to apply to multivariate problems.

Grant set out five criteria for choosing a model and chose Model 11.5 mainly because Model 14.2 was still a work in progress and the assessment is likely to change in a number of ways following a CIE review scheduled for February 2016. In recognition of the likely high bias of Model 11.5, Grant recommended that ABC be held at the 2013 level of 255,000 mt as it was last year.

The Team had a fairly lengthy discussion of the merits of the two models. Representatives of industry argued that the low fixed survey catchability was still credible because the longline fishery caught substantial numbers of large cod on the shelf during the summer when the trawl survey caught almost

none, so clearly the survey was missing some fish present in the area despite the failure of the RACE work to detect them. They also stated their belief that the stock was large and increasing so there was no reason to reduce the ABC. Some team members argued for more caution, on the grounds that the low fixed survey catchability was at best doubtful, Model 14.2 was the more credible model in a number of respects, and hence there was a good chance that even an ABC of 255,000 mt was above the true OFL.

In the end, the Team concurred in the author's recommendation, i.e., to base the 2016 status determination on Model 11.5 despite our long-held reservations about this model, but to hold ABC at 255,000 t. An important consideration for some Team members was that the recommended ABC of 255,000 t does not much exceed the OFL value obtained from the fit of Model 11.5 with survey catchability set to 1.0. We look forward to the development of an improved model after next year's CIE review, incorporating desirable features of Model 14.2 and shedding undesirable features of Model 11.5, including the low fixed survey catchability.

Aleutian Islands Pacific cod

Grant Thompson reviewed the candidate models. This stock has been in Tier 5 since being split from the Bering Sea stock for assessment and management. The present assessment model, now numbered 13.4, is a simple random effects model of the trawl survey biomass trajectory, with process variance the only estimated parameter. Another random effects model, requested by the Team in September and designated 15.6, included the IPHC longline survey CPUE series as well (assumed to have the same process variance as the trawl survey), and estimated an additional parameter to rescale the IPHC series to the same units as the trawl survey. A third candidate, designated 15.7, was an age-structured model similar to Model 14.2 in the Bering Sea but with additional constraints on survey selectivity intended to iron out some odd features of a preliminary fit reported in September.

All models fitted the relevant survey series reasonably well, which in the case of the random effects models was a given. Grant realized that there were some technical questions about the nature of the state variable in Model 15.6 and therefore the meaning of the results. The age-structured model 15.7 again produced peculiar selectivity estimates and displayed a dreadful retrospective pattern. In view of these difficulties Grant recommended sticking with the present model 13.4 for 2016, and the Team agreed. This assessment will get a CIE review along with the Bering Sea in February 2016.